CLAIMS

WHAT IS CLAIMED IS:

1. A method for electropolishing a metal wiring layer on a semiconductor device, comprising the steps of:

immersing a wafer into an electrolyte solution to perform an electropolishing process;

applying a positive voltage to the wafer; and

applying negative voltages to electrodes which are disposed in the electrolyte solution and include a main electrode and a plurality of auxiliary electrodes.

2. The method as claimed in claim 1, wherein the negative voltages are first applied to the main electrode and then to the plurality of auxiliary electrodes.

3. The method as claimed in claim 2, wherein the negative voltages applied to the plurality of auxiliary electrodes are sequentially applied to the electrodes.

4. The method as claimed in claim 1, wherein the negative voltages are applied to the main electrode and the auxiliary electrodes at the same time.

5. The method as claimed in claim 4, wherein the negative voltages applied to the plurality of auxiliary electrodes are sequentially applied to the electrodes.

6. The method as claimed in claim 1, wherein an amount of polishing performed at various regions portion of the wafer is adjusted by causing current or voltages applied to the plurality of auxiliary electrodes to be different from one another.

7. The method as claimed in claim 1, wherein the plurality of auxiliary electrodes are mesh-type electrodes.

8. The method as claimed in claim 1, wherein the plurality of auxiliary electrodes are

annular in shape and concentrically positioned.

9. The method as claimed in claim 1, further comprising the step of stopping supply of negative voltages to the electrodes when the metal wiring layer formed on the wafer adjacent to the auxiliary electrodes is electropolished and a surface of a diffusion barrier film disposed below the metal wiring layer is exposed.

10. The method as claimed in claim 9, wherein the step of stopping the supply of negative voltages to the electrodes is performed by measuring currents flowing between the wafer and the auxiliary electrodes.

11. The method as claimed in claim 9, wherein the step of stopping the supply of negative voltages to the electrodes is performed by measuring respective thicknesses of relevant portions of the metal wiring layer on the wafer adjacent the auxiliary electrodes.

12. The method as claimed in claim 9, wherein the step of stopping the supply of negative voltages to the electrodes is performed by measuring respective optical reflectances of relevant portions on the wafer adjacent the auxiliary electrodes.

13. The method as claimed in claim 1, wherein the electrolyte solution contains phosphoric acid (H_3PO_4).

14. The method as claimed in claim 1, further comprising the step of moving the wafer when the voltages are applied.

15. The method as claimed in claim 14, wherein moving comprises rotating or horizontally shaking the wafer.

16. The method as claimed in claim 1 wherein the auxiliary electrodes are disposed above the main electrode.

17. An apparatus for electropolishing a metal wiring layer on a semiconductor device, comprising:

an electrolyte solution for polishing the metal wiring layer;

a wafer chuck for holding the wafer in a polishing chamber containing the electrolyte solution;

electrodes disposed within the electrolyte solution, the electrodes including a main electrode and a plurality of auxiliary electrodes; and

power sources for supplying a positive voltage to the wafer and negative voltages to the electrodes.

18. The apparatus as claimed in claim 17, wherein the negative voltages are first applied to the main electrode and then to the plurality of auxiliary electrodes.

19. The apparatus as claimed in claim 18, wherein the negative voltages applied to the plurality of auxiliary electrodes are sequentially applied to the electrodes.

20. The apparatus as claimed in claim 17, wherein the negative voltages are applied to the main electrode and the auxiliary electrodes at the same time.

21. The apparatus as claimed in claim 20, wherein the negative voltages applied to the plurality of auxiliary electrodes are sequentially applied to the electrodes.

22. The apparatus as claimed in claim 17, further comprising a means for adjusting amounts of polishing performed on each portion of the wafer by causing current or voltages applied to the plurality of auxiliary electrodes to be different from one another.

23. The apparatus as claimed in claim 17, wherein the plurality of auxiliary electrodes are mesh-type electrodes.

24. The apparatus as claimed in claim 17, wherein the plurality of auxiliary electrodes are annular in shape and disposed concentrically.

25. The apparatus as claimed in claim 17, further comprising a system for determining whether the metal wiring layer formed on the wafer adjacent to the auxiliary electrodes is electropolished and a surface of a diffusion barrier film disposed below the metal wiring layer is exposed, and in response, stopping the supply of negative voltages to the electrodes.

26. The apparatus as claimed in claim 25, wherein the system causes the supply of negative voltages to the electrodes to be stopped by measuring current flowing between the wafer and the auxiliary electrodes.

27. The apparatus as claimed in claim 25, wherein the system causes the supply of negative voltages to the electrodes to be stopped by measuring respective thicknesses of relevant portions of the metal wiring layer on the wafer adjacent the auxiliary electrodes.

28. The apparatus as claimed in claim 25, wherein the sensors cause the supply of negative voltages to the electrodes to be stopped by measuring optical reflectance of the wafer adjacent the auxiliary electrodes.

29. The apparatus as claimed in claim 17, wherein the electrolyte solution contains a phosphoric acid (H_3PO_4).

30. The apparatus as claimed in claim 17, wherein the wafer chuck further includes a driving mechanism for moving the wafer when the voltages are applied.

31. The apparatus as claimed in claim 30, wherein the driving mechanism causes the wafer to be rotated or horizontally shaken.